24. (New) The EPR spectrometer according to claim 23 wherein said microwave generator comprises a semiconductor Gunn type oscillator.

25. (New) The EPR spectrometer according to claim 23 comprising means for detecting the electron paramagnetic resonance of a sample.

26. (New) The EPR spectrometer according to claim 25 wherein said means for detecting the electron paramagnetic resonance of said sample comprising a balance mixer and a detector diode.

27. (New) The EPR spectrometer according to claim 25 comprising means for branching microwave energy from said microwave generator to said ferroelectric single crystal resonator and said means for detecting the electron paramagnetic resonance of said sample.

28. (New) The EPR spectrometer according to claim 27 comprising means for conducting microwave energy from said means for branching microwave energy to said ferroelectric single crystal resonator, from said ferroelectric single crystal resonator to said means for detecting the electron paramagnetic resonance of said sample, and from said means for branching microwave energy to said means for detecting the electron paramagnetic resonance.

29. (New) The EPR spectrometer according to claim 28 wherein said means for conducting microwave energy from said means for branching microwave energy to said ferroelectric single crystal resonator and from said ferroelectric single crystal resonator to said means for detecting the electron paramagnetic resonance of said sample comprising wave guides connecting said rectangular cavity to said means for branching microwave energy and said means for detecting the electron paramagnetic resonance.

REMARKS

Claims 1-21 were pending in the Application. By the above Amendment, Applicants have amended claims 15 and 16, added claims 22-29, and withdrawn the claims 1-14 and 18-21. Upon entry of the present Amendment, claims 15-17 and 22-29 are pending and presented for reconsideration. Applicants respectfully submit that no new matter is introduced by the present Amendment. A marked-up copy of the amended claims and a clean copy of all pending claims as amended herein, are attached.

1. Rejections Under 35 U.S.C. §103(a)

Claims 15-17 stand rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent 3931569 in view of UA 40178A. Applicants respectfully traverse this rejection.

The Office Action states that "US Patent 3931569 discloses an EPR spectrometer having a rectangular cavity with opposing wide and narrow sides (see figure 2), a permanent magnet having planar poles disposed parallel to and in close proximity to the wide sides (see figure 1, reference number 15), a sample hole perpendicular through the narrow side of the cavity (see figure 1, line 12), a radio frequency generator (figure 1, reference 20), two connection wires inserted through holes perpendicular to the narrow sides of cavity on opposite sides of the sample hole (figure 1, follow reference numbers 18 and 19).

The difference between this patent and the instant clams is the lack of a ferroelectric single crystal resonator with a through hole coaxial to the sample hole. UA 40178A, as described in the instant specification, teaches the additional of a $KLiTaO_3$ ferroelectric single crystal resonator having a through hole coaxial to the sample hole (see figure 1) in order to reduce the background signal and strengthen the crystal lattice. The resonator having a shape substantially symmetrical relative to three mutually perpendicular plane and axes with the through hole along on of said axes. The first paragraph of page 6 discloses lithium amounts of 0-3.8% are known. While the reference prefers and claims 0-0.1% this reference does indicate higher amounts are useful. It would have been obvious to one of ordinary skill in the art to employ $KLiTaO_3$ ferroelectric single crystal resonator with a through hole coaxial to the sample hole because the reference teaches it would improve the performance of a spectrometer and the particular material employed by claim 16 is itself particularly useful". Applicants respectfully disagree.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in prior art and not based on applicant's disclosure. MPEP 706.02(j).

1. There is no justification, motivation or suggestion in US Patent 3931569 and UA 40178A to combine these references.

Applicants respectfully disagree with the Examiner's conclusion that "It would have been obvious to one of ordinary skill in the art to employ $KLiTaO_3$ ferroelectric single crystal resonator

with a through hole coaxial to the sample hole because the reference teaches it would improve the performance of a spectrometer and the particular material employed by claim 16 is itself particularly useful".

The mere fact that it is possible for two or more isolated disclosures to be combined does not render the result of that combination proper, absent a logical reason of record that justifies the combination. In the present case, there is no reason to support the proposed combination, other than the statement "The difference between this patent and the instant clams is the lack of a ferroelectric single crystal resonator with a through hole coaxial to the sample hole". However the fact that one reference teaches a narrow cavity EPR spectrometer and another reference teaches using ferroelectric single crystal resonator in conventional EPR spectrometers as a sample signal amplifier is not sufficient to combine the references in order to meet Applicants' novel portable EPR spectrometer with capabilities of high-end research spectrometers.

US Patent 3931569 teaches "... an EPR spectrometer designed from the point of view of arriving at a high sensitivity instrument for examining aqueous samples or other liquid samples of relatively high dielectric loss at room temperature. This invention has provided sensitive, low-cost apparatus for this restricted range of applications" (col. 1, lines 47-53). The US 3931569 goal is achieved by decreasing the resonant cavity Q and, accordingly, power of microwave energy coupled to said resonant cavity. Because of low energy level, the spectrometer can be used for "restricted range of applications" and it is "sensitive" relative to "liquid samples of relatively high dielectric loss" only as was already discussed in Applicants' invention disclosure (see [0011]).

UA 40178A teaches a ferroelectric resonator concentrating power of microwave energy coupled to a conventional, preferable cylindrical, high Q resonant cavity on a sample (page 3, paragraph 8 and page 4, paragraph 1) for increasing a signal to noise ratio (page 4, paragraph 3). Furthermore, applicants submit that there is no reason for the statement "While the reference prefers and claims 0-0.1% this reference does indicate higher amounts are useful" since UA 40178A teaches away from using a lithium concentration higher than 0.1% (pages 6, 7) and there is no evidence in either of references to support such assumption. Clearly, UA 40178A suggests said ferroelectric resonator rather part of the sample setup than a permanent feature of the spectrometer (Fig. 1, pos. 1-4). The teachings of UA 40178A were discussed in Applicants' invention disclosure (see [0004], [0010]).

2. *The proposed combination would not be physically possible or operative.*

Since US 3931569 teaches "The cavity dimension corresponding to the zero index is made small, of the order of an optimum capillary sample tube outer diameter, i.e., 2 mm if the diameter is

1 mm, for apparatus designed to operate at 10 GHz" (col. 1, lines 63-67) and UA 40178A teaches a $KLiTaO_3$ resonator with dimension corresponding to the zero index of 1.5 mm for a sample diameter of less than 0.9 mm (table 2), it would not be physically possible or, at the least, operative to fit said resonator within the spectrometer resonant cavity. Moreover, even if the spectrometer could have been modified, which Applicants submit would be neither ordinary nor obvious even to one highly skilled in the art, resulting combination still would not be operative (see [0004]). Neither reference provides a skilled artisan with the expectation that he or she could practice the claimed subject matter at all or, at least, without undue experimentation.

3. Even if US Patent 3931569 and UA 40178A were to be combined in the manner proposed, the proposed combination would not show the novel features of claim 15 and claims directly or indirectly dependent on it.

Even assuming arguendo that proposed combination of US 3931569 with UA 40178A is possible, resulting EPR spectrometer would still not be portable (col. 2, lines 18-20) and would still be the "apparatus for this restricted range of applications" i. e., "examining liquid samples of relatively high dielectric loss at room temperature". Furthermore, said resulting EPR spectrometer would not show such novel features of the claim 15 as: "a rectangular cavity having opposing wide sides and narrow sides", "a magnet with planar poles disposed parallel and in close proximity to each of said wide sides", "connection holes", said sample hole and said connection holes are perpendicular to and through at least one of said narrow sides of said rectangular cavity", and "said ferroelectric single crystal resonator positioned within said rectangular cavity between said planar poles with said through hole perpendicular to said narrow sides, said sample hole is coaxial with said through hole, said connection holes are located in close proximity to said ferroelectric single crystal resonator, and said connecting wires are inserted in said connection holes".

4. These novel features of claim 15 and claims directly or indirectly dependent on it produce new and unexpected results and hence are unobvious and patentable over these references.

Applicants submit that the novel physical features of claim 15 and claims directly or indirectly dependent on it are also unobvious and hence patentable under §103 since they provide for new and unexpected result over US 3931569 and UA 40178A, or any combination thereof.

This new and unexpected result is the portable EPR spectrometer with capabilities of high-end research spectrometers.

5. *Assuming arguendo that a combination of US Patent 3931569 and UA 40178A is proper, US Patent 3931569 is deficient as a proper anticipatory reference and UA 40178A fails to cure that deficiency.*

Applicants respectfully disagree with the Examiner's conclusion that "US Patent 3931569 discloses an EPR spectrometer having a rectangular cavity with opposing wide and narrow sides (see figure 2), a permanent magnet having planar poles disposed parallel to and in close proximity to the wide sides (see figure 1, reference number 15), ..., two connection wires inserted through holes perpendicular to the narrow sides of cavity on opposite sides of the sample hole (figure 1, follow reference numbers 18 and 19)".

Accordingly, Applicants respectfully suggest that "a rectangular cavity with opposing wide and narrow sides", "magnet having planar poles disposed parallel to and in close proximity to the wide sides", and "two connection wires inserted through holes perpendicular to the narrow sides of cavity on opposite sides of the sample hole" are not taught or suggested in the prior art cited.

Firstly, US 3931569 discloses the EPR spectrometer having <u>microwave resonant cavity</u> (col. 3, lines 61, 62, 65, 66; col. 4, lines 1, 2, 6, 7, 11, 12, 18, 19, 25, 38; FIG. 1, pos. 11; FIG. 2-11) that is dimensioned to one of possible modes of operation for creating a standing wave with given frequency of microwave energy. Said microwave resonant cavity requires a circulator 29 and an adjustable iris 33 to operate (col. 5, lines 24-28).

To the contrary, according to the present invention, a rectangular cavity (FIG. 3, 4, pos. 21) with opposing wide and narrow sides is a structural element for positioning a ferroelectric resonator, a RF inductance, and a magnet and connecting corresponding waveguides that conduct microwave energy to and from the ferroelectric resonator.

Secondly, US 3931569 discloses "coils 18 and 19, respectively, positioned <u>between pole face 16 and wall 13</u> and <u>between wall 14 and pole face 17</u>." (col. 4, lines 48-50). Having the coils placed between the magnet pole faces and the resonant cavity is contrary to "planar poles ... in close proximity to the wide sides". As an outcome, the magnet size and weight is greater because of increased distance between the magnet poles.

Thirdly, US 3931569 discloses "The AC magnetic field component is provided by coils 18 and 19, respectively, positioned between pole face 16 and wall 13 and between wall 14 and pole face 17. Coils 18 and 19 are connected to AC source 20, which typically has a frequency on the order of 100 KHz." (col. 4, lines 47-52). In other words, the coils 18 and 19 are positioned and connected on the outside of the microwave resonant cavity. As a consequence, not only the magnet size but power of the AC source has to be increased.

According to the present invention, the cavity "...has connection holes 28 through its narrow sides. Wires from AC generator 30, which typically has a frequency on the order of 100 KHz, are

inserted trough the holes 28." (FIG. 3, 4). As a result, the magnet size and power of the AC source decrease on the order of magnitude.

Finally, US 3931569 fails to be a proper anticipatory reference for independent claim 15, from which claims 16, 17, and 22-29 directly or indirectly depend. US 3931569 fails to teach or suggest most of limitations of the EPR spectrometer of claim 15, including "a rectangular cavity having opposing wide sides and narrow sides", "a magnet with planar poles disposed parallel and in close proximity to each of said wide sides", "a ferroelectric single crystal resonator", a through hole in said ferroelectric single crystal resonator", "connection holes", said sample hole and said connection holes are perpendicular to and through at least one of said narrow sides of said rectangular cavity", "said ferroelectric single crystal resonator positioned within said rectangular cavity between said planar poles with said through hole perpendicular to said narrow sides, said sample hole is coaxial with said through hole, said connection holes are located in close proximity to said ferroelectric single crystal resonator, and said connecting wires are inserted in said connection holes".

Insofar as the disclosure of UA 40178A fails to cure the deficiencies of US 3931569 with respect to claim 15, claims16, 17, and 22-29 are patentable over US 3931569 in view of UA 40178A.

Therefore, in light of the foregoing reasons and amendments to the claims, Applicants respectfully request that the rejections under 35 U.S.C. §103(a) be reconsidered and withdrawn.

2. Rejection Under 35 U.S.C. §112, second paragraph

Claim 16 was rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. The Office Action states that "The subscripts of claim 16 render its scope indefinite as they each recite two numbers without defining the relationship between them. For purposes of examination, they have been construed as 0.97-0.99 and 0.03-0.01".

Applicants respectfully point out that aforementioned form of notation is commonly used for identifying relative amount of elements in compositions. For example, UA 40178A teaches $K_{1-x}Li_xTaO_3$ (page 6, paragraph 1). In this formula, x identifies limits, in particular, 0.01-0.1% (claim 1). Applicants' invention disclosure discusses "alkali metal substituting from about 1% to about 3% of the potassium" (see [0028] and claim 1). Given x is from 0.01 to 0.03, the formula would be either $K_{(0.99\ \ 0.97)}Li_{(0.01-0.03)}TaO_3$ or $K_{(0.97-0.99)}Li_{(0.03-0.01)}TaO_3$. The later is used in Applicants' invention disclosure.

Nevertheless, Applicants have addressed the Examiner's objection by amending claim 16 and adding claim 22 that resolve ambiguity and provide proper antecedent basis for the limitations, so as to define the invention more particularly and distinctly. Support for the amendments may be found in the originally filed claims 1 and 2. In light of the foregoing amendments to the claims, Applicants respectfully request that the rejections under 35 U.S.C. §112, second paragraph, be reconsidered and withdrawn.

CONCLUSION

Applicants respectfully request that the Examiner reconsider the Application and claims in light of the foregoing Amendment and Response, and respectfully submit that the claims, as amended, are in condition for allowance, which action they respectfully solicit. If, in the Examiner's opinion, a telephone interview would expedite the favorable prosecution of the present Application, the undersigned Applicants would welcome the opportunity to discuss any outstanding issues, and to work with the Examiner toward placing the Application in condition for allowance.

If, for any reason this application is not believed to be in full condition for allowance, applicants respectfully request the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P. § 2173.02 and § 707.07(j) in order that the undersigned can place this application in allowable condition as soon as possible and without the need for further proceedings.

Respectfully submitted,

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MARKED-UP COPY OF AMENDMENTS TO THE CLAIMS

15. (Amended) An EPR spectrometer comprising: [with]

a rectangular cavity having opposing wide sides and narrow sides;[,]

a [permanent] magnet with planar poles disposed parallel and in close proximity to each of said wide sides;[, and]

a radio frequency AC generator with [two] connecting wires;[, comprising:]

a ferroelectric single crystal resonator;

a through hole in said ferroelectric single crystal resonator;

a sample hole; and

[two] connection holes;

said sample hole and said connection holes are perpendicular to and through at least one of said narrow sides of said rectangular cavity, said ferroelectric single crystal resonator positioned within said rectangular cavity between said planar poles with said through hole perpendicular to said narrow sides, said sample hole is coaxial with said through hole, said connection holes are located in close proximity to said ferroelectric single crystal resonator [at opposite sides of said sample hole], and said connecting wires are inserted in said connection holes.

16. (Amended) The EPR spectrometer according to claim 15, wherein said ferroelectric single crystal resonator is a ferroelectric single crystal [composed of $K_{(0.97-0.99)}Li_{(0.03-0.01)}TaO_3$,] consisting essentially of potassium tantalate and alkali metal, said alkali metal substitutes for from about 1% to about 3% of the potassium, said ferroelectric single crystal having cubic form of perovskite crystalline structure is essentially free of impurities and defects.

CLEAN COPY OF ALL PENDING CLAIMS

1. (Withdrawn) A ferroelectric single crystal, consisting essentially of:

the potassium tantalate; and

the alkali metal or the group (V) metal;

said alkali metal substitutes for from about 1% to about 3% of the potassium, said group (V) metal substitutes for a part of the tantalum; and

said single crystal having cubic form of perovskite crystalline structure is essentially free of impurities and defects.

2. (Withdrawn) The single crystal according to claim 1, wherein said alkali metal is lithium, whereby forming a $K_{(0.97-0.99)}Li_{(0.03-0.01)}TaO_3$ composition.

3. (Withdrawn) The single crystal according to claim 1, wherein said group (V) metal is niobium, said niobium substituting of up to about 40% of tantalum, whereby forming a $KNb_{(0-0.4)}Ta_{(1-0.6)}O_3$ composition.

4. (Withdrawn) The single crystal according to claim 3, consisting of lithium substituting for up to 0.1% of potassium.

5. (Withdrawn) A method of production a ferroelectric single crystal consisting essentially of the potassium tantalate and the alkali metal substituting from about 1% to about 3% of the potassium or the group (V) metal substituting in part for the tantalum, said single crystal having cubic form of perovskite crystalline structure is essentially free of impurities and defects comprising the steps of:

a) providing the potassium precursor, a tantalum foil, and the alkali metal precursor or a group (V) metal foil;

(b) heating said tantalum foil in the oxygen, whereby synthesizing the tantalum oxide;

(c) if said group (V) metal required, heating said group (V) metal foil in the oxygen whereby synthesizing the group (V) metal oxide;

(d) creating a mixture of said potassium precursor, said tantalum oxide, and said alkali metal precursor or said group (V) metal oxide;

(e) heating said mixture in a crucible to obtain a melt;

(f) contacting a lower end of a seed crystal with a surface of said melt;

(g) lifting without rotation said seed crystal to grow a single crystal, wherein said crucible is not moved;

(h) separating the grown single crystal from said melt; and

(i) cooling said single crystal to the ambient temperature.

6. (Withdrawn) The method according to claim 5, wherein said potassium precursor is the potassium carbonate K2CO3.

7. (Withdrawn) The method according to claim 5, wherein said alkali metal precursor is the lithium carbonate Li2CO3.

8. (Withdrawn) The method according to claim 5, wherein said group (V) metal foil is a niobium foil.

9. (Withdrawn) A microwave resonator comprising the single crystal according to claim 1.

10. (Withdrawn) The microwave resonator according to claim 9, wherein, for frequencies from about 7GHz to about 15GHz, said single crystal has said $K_{(0.97-0.99)}Li_{(0.03-0.01)}TaO_3$ composition.

11. (Withdrawn) The microwave resonator according to claim 10, characterized by a shape substantially symmetrical relative to three mutually perpendicular planes and axes with a through hole along the longest of said axes.

12. (Withdrawn) The microwave resonator according to claim 9, wherein, for frequencies from about 60MHz to about 10GHz, said single crystal has said $KNb_{(0-0.4)}Ta_{(1-0.6)}O_3$ composition.

13. (Withdrawn) The microwave resonator according to claim 12, comprising biologically inert and a resonant frequency transparent coating and a holder for attaching said microwave resonator to a catheter.

14. (Withdrawn) The microwave resonator according to claim 12, characterized by a shape substantially symmetrical relative to three mutually perpendicular planes and axes with a through hole along one of said axes.

15. (Amended) An EPR spectrometer comprising:

a rectangular cavity having opposing wide sides and narrow sides;

a magnet with planar poles disposed parallel and in close proximity to each of said wide sides;

a radio frequency AC generator with connecting wires;

a ferroelectric single crystal resonator;

a through hole in said ferroelectric single crystal resonator;

a sample hole; and

connection holes;

said sample hole and said connection holes are perpendicular to and through at least one of said narrow sides of said rectangular cavity, said ferroelectric single crystal resonator positioned within said rectangular cavity between said planar poles with said through hole perpendicular to said narrow sides, said sample hole is coaxial with said through hole, said connection holes are located in close proximity to said ferroelectric single crystal resonator, and said connecting wires are inserted in said connection holes.

16. (Amended) The EPR spectrometer according to claim 15, wherein said ferroelectric single crystal resonator is a ferroelectric single crystal consisting essentially of potassium tantalate and alkali metal, said alkali metal substitutes for from about 1% to about 3% of the potassium, said ferroelectric single crystal having cubic form of perovskite crystalline structure is essentially free of impurities and defects.

17. The EPR spectrometer according to claim 16, wherein said ferroelectric single crystal resonator characterized by a shape substantially symmetrical relative to three mutually perpendicular planes and axes with the through hole along one of said axes.

18. (Withdrawn) A NMR spectrometer comprising:

a magnet forming a static homogeneous magnetic field;

a probe with means for transmitting a radio frequency magnetic pulse and detecting NMR signal;

a ferroelectric single crystal resonator; and

a through hole in said ferroelectric single crystal resonator.

19. (Withdrawn) The NMR spectrometer according to claim 18, wherein a resonant frequency of said ferroelectric single crystal resonator is effectively a multiple of the NMR spectrometer frequency.

20. (Withdrawn) The NMR spectrometer according to claim 18, wherein said probe, said ferroelectric single crystal resonator, and said hole are substantially coaxial with said static homogeneous magnetic field axis.

21. (Withdrawn) The NMR spectrometer according to claim 18, wherein said ferroelectric single crystal resonator characterized by a shape substantially symmetrical relative to three mutually perpendicular planes and axes with the through hole along one of said axes.1.

22. (New) The EPR spectrometer according to claim 16, wherein said alkali metal in said ferroelectric single crystal is lithium, whereby forming a $K_{(0.97-0.99)}Li_{(0.03-0.01)}TaO_3$ composition of said ferroelectric single crystal.

23. (New) The EPR spectrometer according to claim 15 comprising a microwave generator having a noise spectrum comparable to a Gunn oscillator as a microwave energy source.

24. (New) The EPR spectrometer according to claim 23 wherein said microwave generator comprises a semiconductor Gunn type oscillator.

25. (New) The EPR spectrometer according to claim 23 comprising means for detecting the electron paramagnetic resonance of a sample.

26. (New) The EPR spectrometer according to claim 25 wherein said means for detecting the electron paramagnetic resonance of said sample comprising a balance mixer and a detector diode.

27. (New) The EPR spectrometer according to claim 25 comprising means for branching microwave energy from said microwave generator to said ferroelectric single crystal resonator and said means for detecting the electron paramagnetic resonance of said sample.

28. (New) The EPR spectrometer according to claim 27 comprising means for conducting microwave energy from said means for branching microwave energy to said ferroelectric single crystal resonator, from said ferroelectric single crystal resonator to said means for detecting the electron paramagnetic resonance of said sample, and from said means for branching microwave energy to said means for detecting the electron paramagnetic resonance.

29. (New) The EPR spectrometer according to claim 28 wherein said means for conducting microwave energy from said means for branching microwave energy to said ferroelectric single crystal resonator and from said ferroelectric single crystal resonator to said means for detecting the electron paramagnetic resonance of said sample comprising wave guides connecting said rectangular cavity to said means for branching microwave energy and said means for detecting the electron paramagnetic resonance.